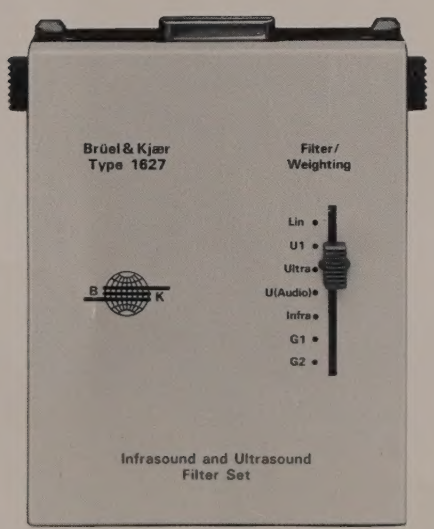
1627

Instruction Manual

Infrasound and Ultrasound Filter Set Type 1627



A Filter Set to make use of the extended frequency range of the Modular Precision Sound Level Meter Type 2231. Its six filter networks include G1 and G2 which allow infrasound measurements (ISO/DIS 7196). Measurements of audible sound in the presence of ultrasonic noise are possible with filter network U (Audio) which complies with IEC TC 29-169/WG 16. The other filter networks are: U1, a proposed weighting which approximates the sensory perception of ultrasound; Ultra, a 12,5 kHz high-pass filter; Infra, a 20 Hz low-pass filter; and Linear. Type 1627 can also be fitted to the Sound Level Meters Types 2230, 2233 and 2234, but only a limited use can be obtained.

A special microphone adaptor is included to extend the useful low frequency range of the ½-inch Microphone Type 4155 or 4165 to below 1 Hz. Type 1627 snaps onto the bottom of Sound Level Meter, forming a self-contained lightweight instrument.

Brüel & Kjær

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Infrasound and Ultrasound Filter Set Type 1627

From serial no. 1177522

August 1985

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Infrasound and Ultrasound Filter Set

USES:

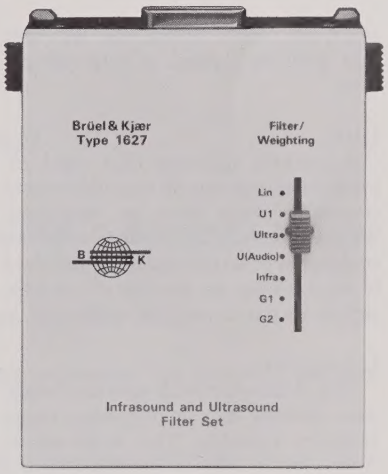
Filter Set for Sound Level Meter Type 2231, (plus limited use with Types 2230, 2233, and 2234)

- Measurement of sound in the infrasonic and ultrasonic frequency ranges
- Measurement of infrasound levels weighted for both auditory magnitude response and indirect non-specific responses
- Measurement of the audible noise emitted by ultrasonic equipment
- Measurement of the ultrasonic disturbances generated by ultrasonic equipment

FEATURES:

- Infrasound filter networks G1 and G2 in accordance with ISO/DIS 7196
- Audio frequency filter network with ultrasound cut-off in accordance with IEC TC 29-169/WG 16
- Three other filter networks; 20 Hz lowpass filter, 12,5 kHz highpass filter, 16 kHz ultrasound weighting, plus Linear
- Special adaptor which extends the useful low frequency range of the standard microphone down to below 1 Hz

Infrasound and Ultrasound Filter Set Type 1627 makes use of the extended frequency range of the Modular Precision Sound Level Meter Type 2231. Its six filter networks (plus Lin.) enable a variety of measurements in the infrasonic and ultrasonic frequency ranges, including measurements according to ISO/DIS 7196 and the proposed IEC TC 29–169/WG 16. Microphone Adaptor Type UC 5265, which is included with the filter set, extends its useful frequency range down to below 1 Hz. Type 1627 snaps onto the bottom of Sound Level Meter Type 2231, forming a self-contained lightweight instrument which is eminently suitable for both field and laboratory work.



The Infrasound and Ultrasound Filter Set Type 1627 is a lightweight filter set which enables the analysis of sound in the infrasonic and ultrasonic frequency ranges. Its primary use is with Modular Precision Sound Level Meter Type 2231. Not only does this Sound Level Meter have the broad linear frequency range necessary for infrasonic and ultrasonic measurements, but it also enables measurements with long integration times. The fluctuating nature of infrasound means that accurate measurements can only be made when long averaging times are used.

Filter Set Type 1627 also includes Microphone Adaptor UC 5265. The adaptor increases the size of the cavity behind the standard Microphone Type 4155 (or Type 4165) and extends its useful low frequency response from around 2–3 Hz down to below 1 Hz. The upper frequency limit of the Sound Level Meter with the standard microphone is approximately 20 kHz, but measurements in the ultrasound range are possible with a microphone of smaller dimensions. Use of the 1/8 inch (pressure response) Microphone Type 4138 gives an upper frequency limit of 140 kHz.

Long term exposure to high levels of noise outside the audible frequency range can have harmful effects. Increasing awareness to this fact is just now giving rise to international measurement standards. ISO/DIS 7196 concerns itself with methods for describing infrasound and proposes two frequency weighting curves in the infrasonic region: G1 and G2. G1 weighting approximates threshold and direct (auditory magnitude) perception; G2 weighting is proposed for the assessment of non-specific reactions. A recent IEC draft standard (TC 29–169/WG 16) describes the characteristics of filters for the measurement of audible noise emitted by ultrasonic equipment. Measurements according to each of these standards may now be made with the Type 1627 Filter Set together with the Sound Level Meter Type 2231 or, for IEC TC 29–169/WG 16, with Type 2230, 2233, or 2234.

Type 1627 contains 6 filter networks plus a linear (All Pass) setting. The characteristics of the filter networks are shown graphically in Fig. 2. The filter settings are as follows:

Lin

A linear or "All Pass" setting which effectively by-passes the Filter Set.

U1

A proposed ultrasound weighting which approximates the perceptory response to sound above 20 kHz. The slope of the weighting curve at 20 kHz leads to a smooth transition between it and the A and C weighting curves. This is important since many practical ultrasound sources operate between 15 kHz and 30 kHz. The peak in the weighting curve occurs at 16 kHz. Below this frequency the drop-off is

Fig. 1. Sound Level Meter Type 2231 with Infrasound and Ultrasound Filter Set Type 1627

18 dB per octave; above this the curve falls away at a slope of 6 dB per octave.

Ultra

A 12,5 kHz highpass filter which allows measurements in the ultrasound frequency range with no weighting. Such a filter may be required when an evaluation of an ultrasonic sound field is required but no account of the subjective response need be taken.

U (Audio)

The U filter network provides bandpass filtering in the frequency range 10 Hz to 12,5 kHz. This is in accordance with the IEC draft standard TC 29–169/WG 16. Its intent is to ensure that measurements of sound levels in the audible range are not disturbed by sound levels in the ultrasonic range.

Infra

A 20 Hz lowpass filter which allows measurements in the infrasound frequency range with no weighting. The weighting curve is linear down to about 1 Hz.

G1

An infrasonic frequency weighting curve proposed in ISO/DIS 7196 which approximates direct human perception. The peak in the weighting curve occurs at 20 Hz. Below this frequency the curve falls away at a slope of 12 dB per octave down to 1 Hz and thereafter 18 dB per octave; above 20 Hz the drop-off is 24 dB per octave.

G2

Also proposed in ISO/DIS 7196, this is an infrasound weighting curve which accounts for non-specific reactions and indirect effects. Here the perception mechanism is non-direct and is less dependent on the frequency of the infrasound. The peak in the weighting curve occurs at 20 Hz. Below this frequency the curve falls away at a slope of 6 dB per octave down to 1 Hz and thereafter 12 dB per octave; above 20 Hz the drop-off is 24 dB per octave.

The active filters contained in the Filter Set are powered from the Sound Level Meter through the 15 pin connector, provided the EXT. FILTER switch on the Sound Level Meter is set to "In". The battery pack in the Filter Set contains 4 cells IEC LR 6 (B&K No. QB 0013) and is always connected in parallel with the battery pack in the Sound Level Meter. The battery life (alkaline cells) of the Sound Level Meter/Filter Set is approximately 8 hours.

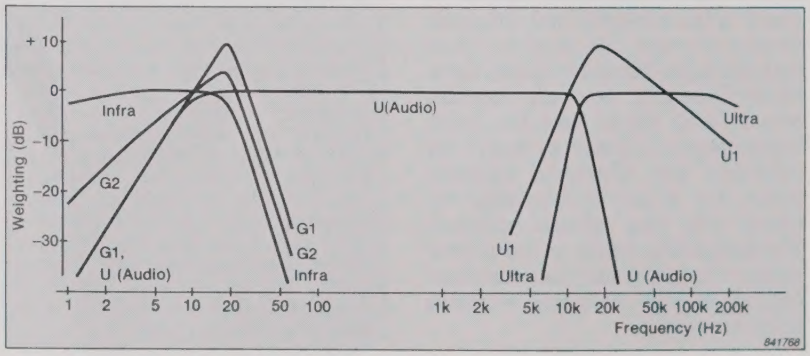


Fig. 2. Filter characteristics of the Filter Set Type 1627

Specifications 1627

Frequency Range:
Selective 1 Hz to 200 kHz
Linear 1 Hz to 200 kHz (−3 dB)

Filters:
U1 : 16 kHz Ultrasound Weighting
Ultra : 12,5 kHz Highpass Filter
U (Audio): U Weighting acc. to IEC TC 29–169/WG16 (10 Hz to 12,5 kHz bandpass)
Infra : 20 Hz Lowpass Filter
G1, G2 : 20 Hz Infrasound Weightings acc. to ISO/DIS 7196

Attenuation at Reference Frequencies: (i.e. 10 Hz, 1 kHz, or 63 kHz): 0 dB = 0,5 dB

Input Impedance: 10 kΩ in series with 6,8 μF

Input Terminating Impedance: ≤100 Ω

Input Voltage: Max. 2 V RMS (2,8 V Peak)

Output Impedance: <5 Ω

Output Terminating Impedance: ≥10 kΩ in parallel with 100 pF

Inherent Noise:
Lin, U1, Ultra :250 μV max.
U (Audio), Infra, G1, G2 :200 μV max.

Magnetic Sensitivity (50 Hz): Approximately 1 mV output for 100 A/m field strength

Operating Temperature: −10 to + 50°C (+ 14 to +122°F)

Storage Temperature: −20 to +50°C (−4 to +122°F), Batteries Removed

Influence of Temperature on Attenuation: < 0,5 dB (−10 to +50°C)

Influence of Humidity on Attenuation: < 0,5 dB for 0 to 90% relative humidity at ≤ 40°C without condensation

Batteries: 4 × 1,5 V IEC Type LR6 (QB 0013). Batteries used as extra supply for SLM

Dimensions: Length 105 mm (4,1 in) – Width 85 mm (3,3 in) – Height 47 mm (1,8 in)

Weight: 450 g (1 lb) including batteries

ACCESSORIES INCLUDED:
Cells (×4)..... QB 0013
Low Frequency Microphone Adaptor..... UC 5265

2. CONTROLS

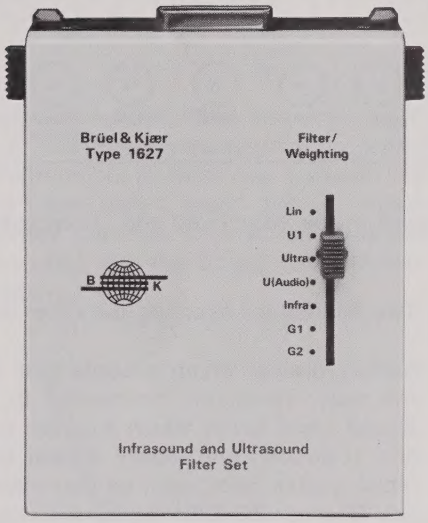


Fig. 2.1. Front view of the Filter Set Type 1627

Filter/Weighting: Cursor for selection of the following filter characteristics (see also Fig.1 page 2):

"Lin." ("All-Pass") effectively by-passes the Filter Set.

"U1" a proposed weighting which approximates the sensory perception of ultrasound.

"Ultra" high-pass filter for ultrasound measurements with lower limiting frequency of 12,5 kHz.

"U(Audio)" complies with IEC TC 29-169/WG 16, and allows measurement of audible sound in the presence of ultrasonic noise.

"Infra" low-pass filter for infrasound measurements with upper limiting frequency of 20 Hz

"G1" in accordance with ISO/DIS 7196. G1 weighting approximates threshold and direct perception for infrasound measurements.

"G2" in accordance with ISO/DIS 7196. G2 weighting is proposed for the assessment of non-specific reaction to infrasound.

Connector: 15-pin connector for directly coupling the Filter Set Type 1627 to the Sound Level Meters Types 2230, 2231, 2233 and 2234. This connector ensures signal connection, plus interconnects the Filter Set and Sound

Level Meter batteries for powering the Filter Set only when **Ext. Filter "In"** mode on the Sound Level Meter is selected. To fit the Filter Set, remove the protective plastic cover from the bottom of the Sound Level Meter.

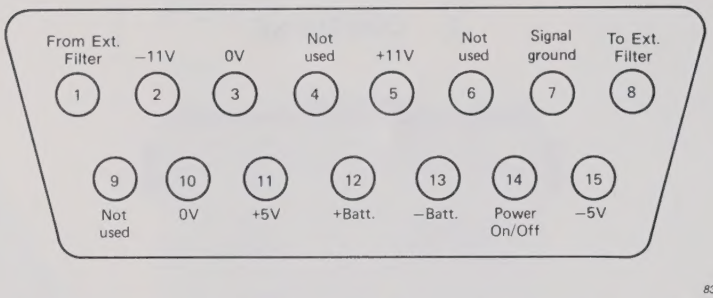


Fig. 2.2. 15 pin connector of the Infrasound and Ultrasound Filter Set Type 1627

Latches: Two latches for securing the Filter Set to the Sound Level Meter.

Battery Drawer: Battery drawer which accepts four 1,5 V alkaline cells (IEC type LR6, AA size). These are connected in parallel with the batteries in the Sound Level Meter which supplies power to the Filter Set (see section 3.2). If desired the battery drawer may be replaced by one fitted with rechargeable cells, such as that obtained with the Mains Power Supply and Charger ZG 0254 (optional extra).

Microphone Adaptor UC 5265: Screw-fit adaptor for extending the lower limiting frequency of B&K 1/2-inch microphones. When used with Microphones Types 4155 or 4165 a lower limiting frequency of less than 1 Hz is obtained. When mounted, this Adaptor results in a 0,4 dB attenuation in the input stage which must be compensated for when calibrating the Sound Level Meter; i.e. when using the internal reference signal, the Sound Level Meter must be calibrated to 94 dB + K_O + 0,4 dB.

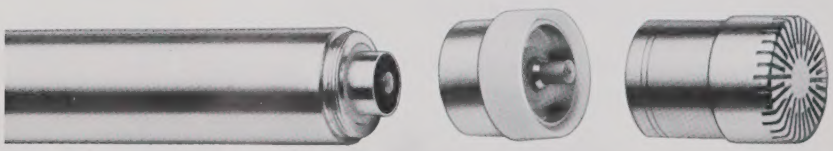


Fig. 2.3. Microphone Adaptor UC 5265 for low frequency measurements

3. OPERATION

3.1. PRELIMINARY

The Infrasound and Ultrasound Filter Set Type 1627 and the Sound Level Meters Type 2230, 2231, 2233 or 2234 have matching 15-pin push-fit connectors which facilitate direct coupling of the instruments to form one compact unit. (See Fig.3.1). To attach the Filter Set to the Sound Level Meter, press the two side-latches and engage the connectors using a gentle steady pressure to push the Filter Set and Sound Level Meter together. When correctly secured with the Sound Level Meter, the two side latches should return to their outer position.

Fig. 3.1. Filter Set with the Sound Level Meter Type 2231

3.2. POWER SUPPLY

3.2.1. Battery Check

The Filter Set is powered via the particular Sound Level Meter connected. The batteries contained in the Filter Set are not used to power the Filter Set directly, but to increase the capacity of the Sound Level Meter's power supply. When using the Filter Set with Sound Level Meter Type 2231 and alkaline batteries are fitted in both instruments, the battery life is approximately 8 hours.

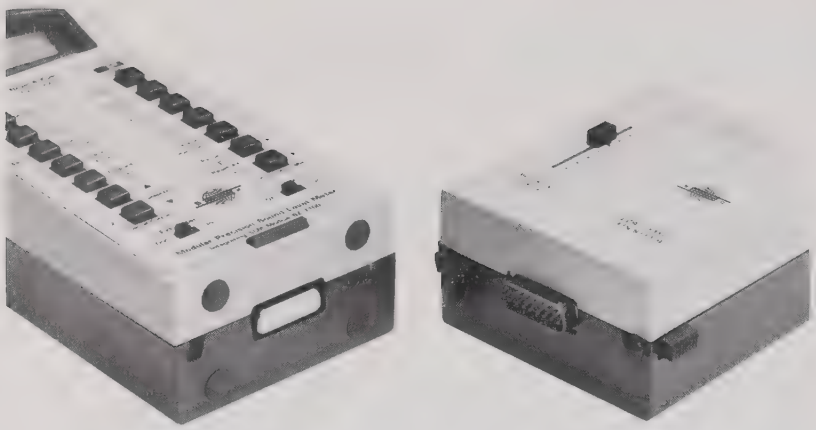


Fig. 3.2. Mounting the Filter Set on the Sound Level Meter Type 2231

To check the battery level of the Filter Set, connect the Filter Set to the Sound Level Meter and remove the battery drawer from the Sound Level Meter. Switch on the Sound Level Meter and check the battery condition indicated on its display (See Sound Level Meter Instruction Manual). If a battery "low" indication is given, the batteries should be replaced.

Note: One set of batteries, either in the Sound Level Meter or in the Filter Set, is sufficient for powering both instruments. However, the battery life is of course reduced.

For long term storage, it is recommended that the batteries are removed to conserve their life time and as a general safety precaution.

3.2.2. Battery Replacement

Unlock the battery drawer and pull it out. Remove the deplenished batteries and place four new ones with polarities as shown in the battery drawer. Push the drawer back into place until the lock is secured.

Fig. 3.3. Battery replacement

3.2.3. Mains Power Supply and Charger ZG 0254 (option)

The battery drawer of the ZG 0254, containing 4 rechargeable cells, fits into the Filter Set Type 1627 and can be recharged either in or outside the instrument via the socket on the side. The Charger delivers enough current for simultaneously powering the Filter Set and Sound Level Meter and recharging the cells to which the charger is attached. When only recharging the cells (drawer pulled out or instrument switched off), a recharging cycle takes approximately 5 hours. When recharging cells while powering the instrument, the recharging time is of course longer.

Note: It is not necessary for both battery sets, in the Sound Level Meter and in the Filter Set, to be rechargeable. To avoid confusion, however, only battery drawers equipped with rechargeable cells have the socket receiving the charger. If both instruments contain rechargeable cells, it is necessary to use a separate battery charger with each instrument.

Fig. 3.4. Mains Supply and Charger

3.3. MEASUREMENT

3.3.1. General

In the following sections emphasis is placed on the practical aspects of making infrasound or ultrasound measurements with a Sound Level Meter and the Filter Set Type 1627. For a comprehensive description of the philosophy and reasons for infra or ultrasound measurements consult the relevant standards and the various publications on this subject.

To include the Filter Set in the measurement chain set the **Ext. Filter** switch on the Sound Level Meter to **"In"**. The signal measured with the Sound Level Meter is then filtered or weighted according to the position of the **Filter/Weighting** switch on the Filter Set.

3.3.2. Instrumentation

Before attempting any measurement a basic but important rule is to make sure that the frequency range of interest is covered by every item in the measuring chain, i.e. the Microphone, the Sound Level Meter, the Sound Level Meter weighting (if any) and finally the Filter Set itself.

If the frequency range of the Sound Level Meter microphone does not cover the frequency span of interest, a different microphone should be selected. For example, for ultrasound measurements, the 1/4″ Microphone Type 4135 (4 Hz–100 kHz, ±2 dB) with Adaptor UA 0035 can be fitted to the Sound Level Meter Type 2231; and for infrasound measurements, the frequency range of the Microphones Type 4155 or 4165 can be extended downwards (to less than 1 Hz) by use of the supplied Microphone Adaptor UC 5265.

For making a measurement it is then just necessary to check that the frequency of interest is contained in the Sound Level Meter frequency range, and that the "Lin." (All-pass) frequency weighting is used.

Note:
– If a non-standard microphone is selected, remember to use the **"Frontal"** setting on the Sound Level Meter, as the **"Random"** frequency correction is not valid for any microphone.
– When mounted, the Adaptor UC 5265 results in a 0,4 dB attenuation in the input stage which must be compensated for when calibrating the Sound Level Meter; i.e. when using the internal reference signal, the Sound Level Meter must be calibrated to 94 dB + K_O + 0,4 dB.

3.3.3. Measurement

Proceed as for a normal measurement with an external filter, i.e. with **Ext. Filter** set to **"In"**. The measured sound pressure level is displayed by the Sound Level Meter.

For **low frequency** measurements long integration times must be allowed. When measuring with an Integrating Sound Level Meter, these can be obtained by use of the L_{eq} measurement function (see Sound Level Meter Instruction Manual). As a rough guide, the integration time can be defined as the time needed for the displayed value to stabilize. A minimum integration time of 8 seconds (i.e. an 8 seconds L_{eq}) is recommended, although for very low frequencies this value can be as high as 60 seconds or even more.

For **high frequency** measurements no special precaution are needed concerning the integration time. However, care must be taken to avoid introducing reflections (e.g. from body of the operator) which can have a marked effect on the accuracy of the measurement, especially at high frequencies.

4. APPENDIX

Lin	U1	Ultra	Audio	Infra	G1	G2
32 dB	23 dB	28 dB	17 dB	27 dB	21 dB	19 dB

T00843GB0

Table 4.1. Inherent noise level of 2231 with 1627

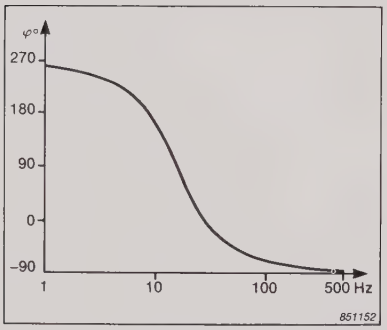


Fig. 4.1. Input/Output phase shift with "U1" Filter

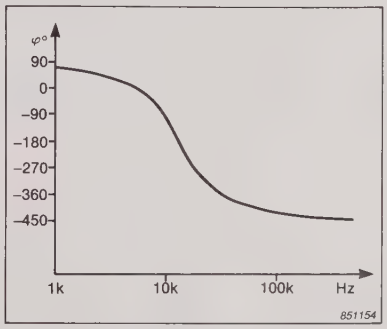


Fig. 4.2. Input/Output phase shift with "Ultra" Filter

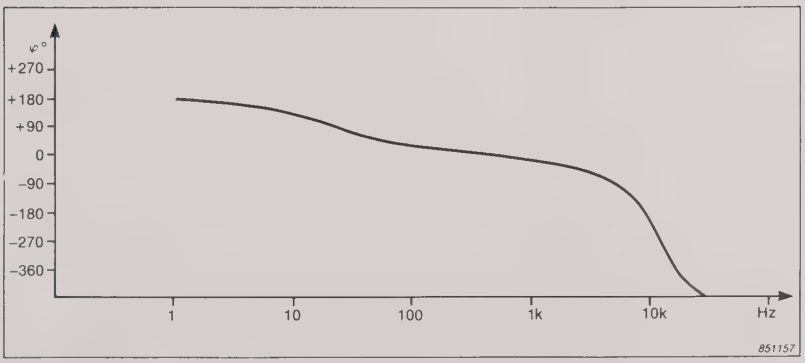


Fig. 4.3. Input/Output phase shift with "Audio" Filter

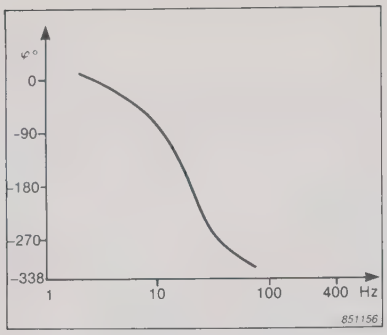


Fig. 4.4. Input/Output phase shift with "Infra" Filter

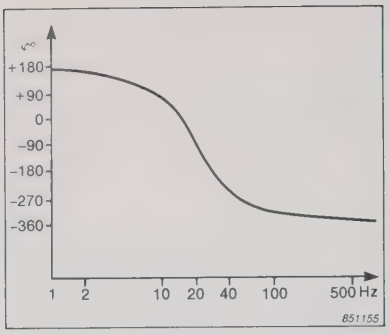


Fig. 4.5. Input/Output phase shift with "G1" Filter

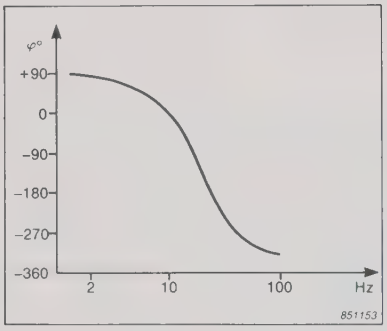
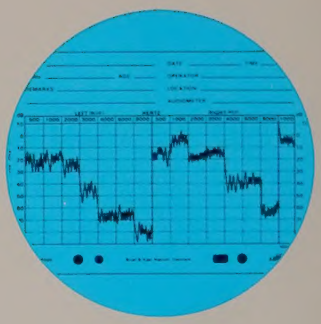
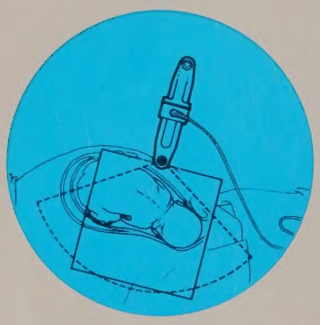


Fig. 4.6. Input/Output phase shift with "G2" Filter

5. SERVICE AND REPAIR

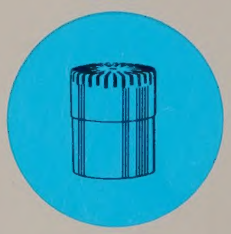
The Type 1627 is designed and constructed to provide the user with many years of reliable operation. However, should a fault occur which impairs its correct function, then its internal batteries should be removed to prevent risk of further damage. For repair consult the separate Service Instruction Manual available for the Type 1627 or contact your local B & K service representative. Under no circumstances should repair be attempted by persons not qualified in the service of electronic instrumentation.



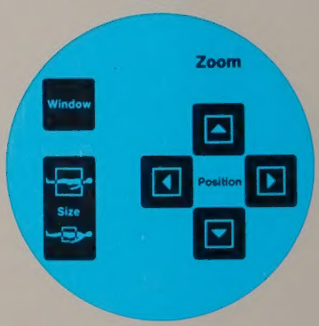


FREQ. Hz
LEVEL dB
MAX

8.8.8.8



Selectivity Control
100 Hz
31.6 Hz
316 Hz
10 Hz
3160 Hz
Ext Filter


Zoom
Window
Size
Position

1560
Frequency
Preset
Amplitude
Track

20652